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Short Communication

Iron Filings as Magnetically Retrievable Markers

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ABSTRACT

*Iron filings (plain, red-painted and red-fluorescent-painted) in tallow baits were tested as bait acceptance markers for coyotes (*Canis latrans*). The paint coatings did not survive digestive passage. Based on very small numbers of treated animals, recovery period of iron filings appeared longer than for two types of particle markers examined by others. Iron filings would be simple to use, readily available and inexpensive.*

INTRODUCTION

Physical and physiological markers in baits are valuable tools that help researchers define bait acceptance by target and nontarget animals and can be used in a variety of field simulation experiments for studying pesticide delivery. Nass and Hood (1969) used the nontoxic acid-base indicator bromcresol green (3,3′,5,5′-tetrabromo-*m*-cresolsulfonephthalein) as a bait-acceptance marker for small mammals. Johns and Pan (1982) investigated the use of fluorescent chemicals, quinacrine dihydrochlorde and rhodamine B, for systemic marking of coyotes and rats. Fall and Johns (1988) described the use of metallic flake particles to determine feeding behavior of rats at bait points and reviewed the use of conventional markers for studies of wild rats. Metallic flakes used by Fall and Johns (1988) in coyote bait tests were evident in scats up to 5 days after bait consumption (Zemlicka, personal communication; manuscript in

preparation). Microtaggants with a ferromagnetic layer to allow recovery by magnet have been used to study coyote food consumption, but recovery times were not estimated (Johns & Thompson, 1979). Early work with coyotes used demethylchlortetracycline (Linhart & Kennelly, 1967), Mirex and iophenoxic acid (Larson *et al.*, 1981) as physiological marking agents for baits. Linhart *et al.* (1968) and Knowlton *et al.* (1986) described field studies using these markers to assess coyote bait acceptance. Radioisotopes have also been used as bait markers (Knowlton *et al.*, 1989). While systemic or physiological markers have a substantial advantage over small inert particles by being detectable for longer periods, they are costly and require substantial laboratory preparation and analytical equipment. We made preliminary observations on commercially available iron filings in beef tallow baits to determine if these particles were retrievable from coyote scats. This study was done according to a research protocol approved by the DWRC Animal Care and Use Committee. Reference to trade names of commercial products for identification purposes does not imply an endorsement or recommendation by the authors or the US Department of Agriculture.

MATERIALS AND METHODS

Three samples of iron metal filings (fine grade, Colorado Scientific Instrument and Supply Co., Denver, CO), *ca* 300 g, were prepared as treatments. These filings, evidently recovered from waste product, were specified as passing 35–60 mesh screens. Thus, particles ranged between about 423–726 μm in maximum dimensions as compared with metallic flakes (422 × 374 × 34 μm; Fall & Johns, 1987) and Microtaggants (100% passage of a 425 μm screen; Johns & Thompson, 1979).

Two samples of filings were sprinkled from a vibrating spatula about 1 m from a receiver and sprayed in midair with red Zynolyte® spray paint (Red 7046) or red Zynolyte® fluorescent spray paint (Red 1418). The Material Safety Data Sheet indicated that the only toxic components of the spray paint were toluene and methylene chloride, which are volatile and evaporated during spraying. The painted iron filings were non-toxic. The third sample remained unpainted in the original state. For each bait, 20 mg of the appropriate iron filing preparation were incorporated into the center of double poured, molded beef tallow to form plain, red-painted, and fluorescent-painted 4·5 g iron filing baits. Adult coyotes were randomly separated into three groups of two and given a tallow bait at 8:00 a.m. on the initial day of the test. Scats were collected from each animal for 7 consecutive days after bait consumption. Two scats from

untreated captive coyotes maintained in the same facility were collected as reference specimens.

All tallow baits were missing from pen floors soon after placement and were presumed eaten by the coyote. One scat pile from each coyote was collected for examination each morning, although some coyotes defecated twice within 24 h. Each scat was suspended and dispersed in 150 ml of water and a Teflon[R]-coated magnet was used to probe for magnetically responsive particles on the bottom and walls of the beaker. A 20× magnifying glass was then used to examine the magnet for iron filings. Because we questioned our lack of detection of uncoated iron filings in scats, tallow baits formulated in the same manner with plain, uncoated iron filings were later offered to two more coyotes. Only two coyotes were used for a 5-day period in this second test.

RESULTS

In the first test group, no iron filings were found in the two scats from wild coyotes, nor in any of the 14 scats from two coyotes receiving the plain iron filing baits (Fig. 1). All eight scats from four coyotes from day 1 and day 2 for the red painted and fluorescent red painted treatments were

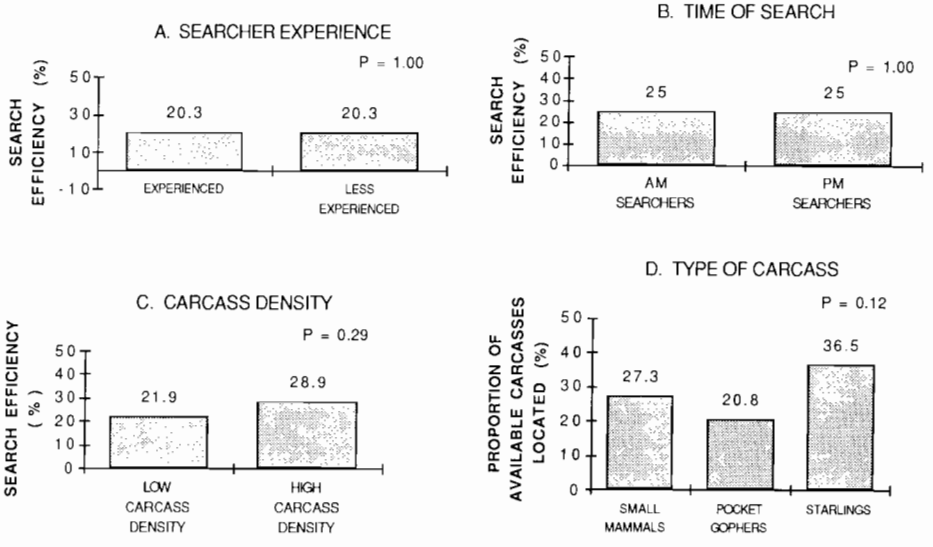

Fig. 1. Magnetic recovery of iron filings from coyote scats from animals that consumed treated tallow baits. One group of coyotes received three treatments and was followed for 7 days; a second group received baits containing only plain iron filings and was followed for 5 days.

negative for iron filings; however, all 20 scats from four coyotes from days 3, 4, 5, 6 and 7 contained iron filings. Neither red nor fluorescent paint was evident on any of the iron filings recovered. In the second group, filings were found in scats from one coyote on days 3, 4 and 5, and in the other on days 1, 2, 3 and 4. The numbers of iron filings recovered from individual scats were low.

DISCUSSION

The disappearance of the red and red-fluorescent paints from the recovered iron filings suggested that the coatings were dissolved or abraded during digestive passage. Since none of the plain iron filings were recovered from scats in the first group of coyotes, we suspected that these were dissolved in stomach acid and that the plain coatings, although removed during digestion, retarded solvation. Since plain iron filings were recovered from the two coyotes in the second group on 5 days following ingestion, the explanation of these results is obviously more complex and would require further experimental work. We expected that imbedding these particles in tallow baits would provide some protection during at least the early stages of digestion, but it is not clear from our results if this occurred.

The encouraging aspect of our findings was the persistence and consistent recovery of iron filings with or without coating of the originally paint-coated ones over a more lengthy period than had previously been demonstrated for other particle markers studied with coyotes. This persistence could have related to particle size, the irregular shapes of particles, or a variety of other variables related to canid digestive processes. There is a continuing need for suitable marking agents that can be used at low cost, with simple detection methods, to facilitate the sorts of studies undertaken by Linhart *et al.* (1968) and Knowlton *et al.* (1986). Iron filings can be recovered from industrial waste. Such a need has become an important consideration recently, as new efforts are being made to develop oral delivery methods for rabies and contraceptive vaccines for coyotes. We suspect that further work with coated iron particles might prove productive in view of the fact that the paint coating apparently prolonged the life of this unique iron marker.

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